23 Apr 1938

The Engineer Looks Ahead (1938)

Missouri School of Mines and Metallurgy

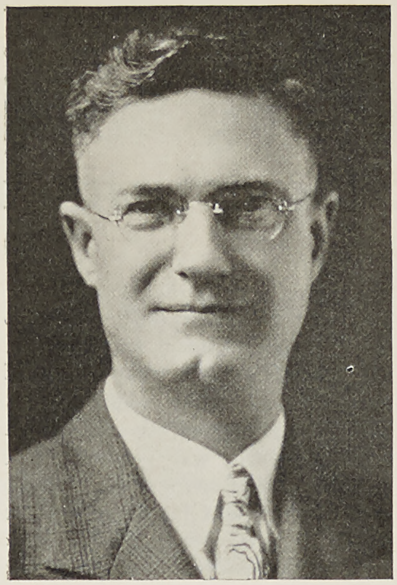
The Engineer Looks Ahead

Engineers' Day Program

Missouri School of Mines and Metallurgy

ROLLA - - - - - MISSOURI

April 23, 1938



To the High School Students of Missouri . . . .

The Missouri School of Mines and Metallurgy as host to the Missouri Academy of Science and the Junior Academy of Science desires to extend to you, your science teachers and your parents a cordial invitation to attend these meetings.

The adult section will meet April 21st to 23rd inclusive. The junior section will meet on April 23rd only, with their own program and exhibits, in the Jackling gymnasium of the Missouri School of Mines and Metallurgy.

As one of the features of the Junior Academy meeting the students and faculty of the Missouri School of Mines and Metallurgy have prepared various engineering and scientific exhibits and demonstrations illustrating the different fields of engineering science. These exhibits and demonstrations will be open to the Junior Academy and others from 2:00 to 6:00 p. m. and 7:00 to 9:00 p. m. on Saturday, April 23rd.

The exhibits and demonstrations should be of special attraction to those particularly interested in and having an aptitude for engineering as a possible career. They will also be attractive to those interested in other fields of science.

All those interested in the science field, whether members of the Junior Academy or not, are cordially invited to attend. A detailed program of the Junior Academy meeting has been sent to you by Mr. W. F. Shay of the science department of the Normandy High School.

The program for Engineers Day is outlined on the back of this publication. The students and faculty of the Missouri School of Mines and Metallurgy hope to see representatives from your school here on April 23rd.

Very sincerely yours,

Wm. R. Chedsey

Director of the School of Mines and Metallurgy

A School of Technology

(the MISSOURI SCHOOL OF MINES)

By A. E. STRAUB, '40

Although the Missouri School of Mines was established only sixty-eight years ago, the seed which brought it into being was sown at the birth of our republic. The framers of the constitution made education one of the corner stones of the structure of our government. Since that time, the leaders of our country have done everything possible to promote the general welfare of the people of the United States, and the advancement of education has been one of our governments' greatest accomplishments.

As early as 1804 the need for a school of mines was appreciated, but it was not until 1836 that Missouri took official notice of the necessity for study of her mineral resources. In 1848, Governor Austin B. King recommended that the Federal government be asked for assistance in making a geological survey of Missouri and, also, for aid in establishing a national school of mines. The request was not granted, but the state made her own appropriations for a geological survey and national recognition was given to the idea of having such a school.

The passage of the Morrill Land Grant act by Congress in 1862 gave the School of Mines its real beginning. This bill offered to the states, under certain conditions, grants of land, the sale proceeds of which were to be used for the endowments of colleges. In 1863, Missouri accepted the conditions of this act and the Missouri School of Mines was finally "on her road to Rolla."

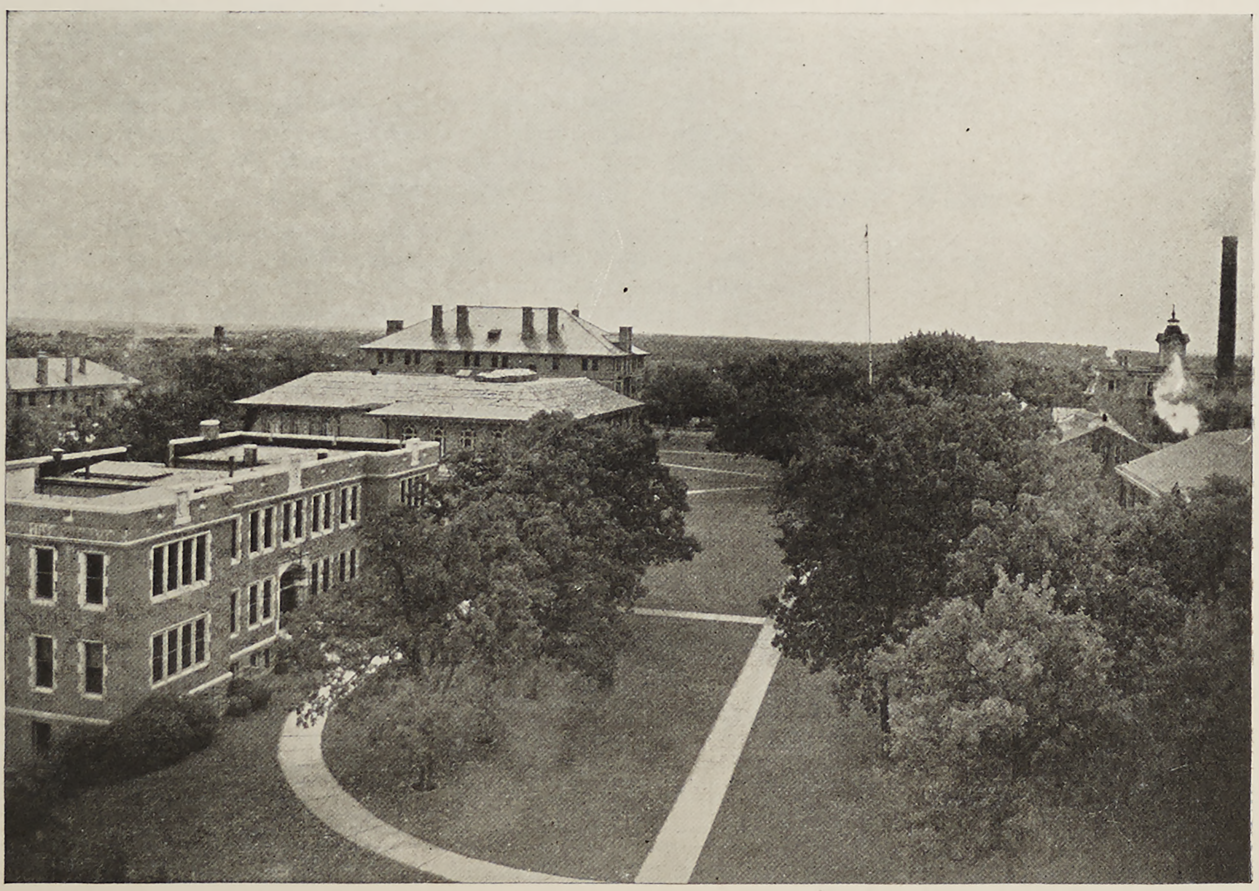
The "road," however, was a long one. For a period of several years the legislature engaged in a bitter struggle over conflicting ideas about where the school should be located and whether or not it should be connected with some other existing college in the state. A compromise was finally affected by which the School of Mines was to be placed at Rolla as an engineering department of the state university.

The formal opening of the technical school took place on November 23, 1871. Professor Charles P. Williams, State Geologist of Delaware was the first director. Laboratories were improvised and much of Professor Williams' own equipment was used. The first class to graduate was that of 1874 which consisted of three men.

The enrollment of the school for the next few years was very small; but after 1885 new courses were added to the curricula, new buildings were built on the campus, new equipment was acquired, and slowly but surely the class rolls became larger.

The enrollment of the school, today, is approximately 700 students. The Missouri School of Mines rates as one of the best engineering schools in the United States, and her students gain an excellent education at a minimum cost. Many of her graduates are famous men; few have failed to make good. Perhaps the greatest compliment which has been paid to the school is that it "combines theory with practice."

When completely considered from beginning to end, the whole historic study of the school reveals the fact that the Missouri School of Mines' educational services increase the wealth and well being of not only Missouri but of the whole nation!



Geology and Mineral Resources of Missouri

By H. A. BUEHLER, State Geologist

Lying as it does in the center of the great agricultural region of the Mississippi Valley, Missouri is not usually thought of as one of the important mining states. However, there is no state in this great central region that has a greater variety of commercial mineral deposits, nor has the development of the mineral resources of any state throughout the Middle West been so vital a factor in its early progress and later prosperity.

The very first settlements in the state were established in the search for gold and silver and although the precious metals were never found, rich lead mines were discovered and worked as early as 1725, in southeast Missouri. The exploration for iron ores over a century ago established centers of industry in the Ozark region and the opening of rich zinc and lead deposits in the Joplin district in 1849 brought the first real influx of people in the exciting mining boom that followed. It is reported that prior to 1840 coal was mined in north Missouri.

Based on these rich deposits Missouri has steadily advanced as a mining state with new discoveries in old fields and the development of new mineral industries. Today Missouri ranks fourteenth among the states in the value of its minerals produced. The wide range and varied character of the geological formations underlying the state is responsible for the widely different character of the mineral deposits.

Topographically the state can be divided into three major divisions. Roughly speaking the northwestern half of Missouri is typically rolling prairie country similar to southern Iowa and eastern Kansas. Underlain by a rich soil this area constitutes the productive agricultural area of north Missouri. Occupying a large part of the southern half of the state is the so-called Ozark region, which is chiefly a wooded, rough, hilly, well-drained upland having a maximum elevation of 1800 feet on Taum Sauk Mountain, in Iron County. The third division, the lowland area of southeast Missouri, covers approximately seven counties and is the northernmost part of the great Mississippi embayment extending from the Gulf to Cape Girardeau. Throughout this area there is very little surface relief.

Geologically these divisions have as great a diversity as in their topographic expression and each is underlain by formations of different geological age. The oldest rocks of the state outcrop in Madison, St. Francois, Iron, Shannon, Carter and adjoining counties. The deep red granite and dark-fine-grained porphyries comprising these rocks are a part of the great basement complex underlying the entire state. These rugged hills known as the St Francois Mountains are composed of the oldest rocks known in the central Mississippi Valley. They have produced iron ore, tungsten, a small amount of lead ore and are the source of the rich, warm red granite quarried at Graniteville.

In the region surrounding the igneous rocks occur the oldest sedimentary formations exposed in the state. These include the Lamotte sandstone, Bonnetterre dolomite, Davis Shale and Derby Doerun dolomities. The series has a thickness of approximately 900 feet. The cobalt nickel copper ores of the Fredericktown district and the great disseminated lead deposits of St. Francois and adjoining counties occur in the Bonneterre dolomite.

Much of the remaining area of the Ozark region is underlain by the Ordovician series of sandstones and dolomites which form the picturesque bluffs along the major streams throughout south Missouri. The lowest member of this series is the Potosi dolomite which outcrops chiefly in Washington and adjoining counties. From this formation and the overlying Eminence the major part of the barytes produced in Missouri is obtained. The Potosi is overlain by the Eminence and Proctor dolomites which in turn are covered by the Gunter sandstone, one of the most important water horizons in Missouri.

In descending order the Van Buren and Gasconade dolomites outcrop chiefly in the central Ozark region, and in these formations occur many of the large caves and springs of the Ozarks. The red iron ores of the Ozark region occur chiefly in these formations.

Next younger is the Roubidoux sandstone which is the surface formation throughout Dent and adjoining counties. A series of dolomites known as the Jefferson City, Cotter and Powell formations overlie the Roubidoux formation and form the higher ridges and plateaus throughout the southern part of the state.

The Ordovician formations already mentioned outcrop over most of the central Ozark region. The younger Ordovician formations which are found chiefly in the narrow belt extending from the Missouri River north to Pacific and south to Cape Girardeau. Prominent among these is the St. Peter sandstone which is pure white silica sand and is used largely in the manufacture of plate glass.

Overlying the St. Peter the Joachim dolomite, Plattin and Kimmswick limestones parallel the outcrop of the St. Peter. The Kimmswick formation is used extensively in the manufacture of lime and smelter flux. The younger Silurian and Devonian formations occur chiefly along the eastern border of Missouri. In the ascending column they are the Hudson River, Niagara,

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BIG SPRING

The Miners Go to A Party

AS PART OF THE MSM SOCIAL LIFE

By BASIL COMPTON

The Social Life at MSM consists chiefly of dances, general lectures, and fraternity and church parties. Most of the public dances are under the direction of the St. Pat's Board, which is composed of members of each fraternity and the Independents. In addition to the dances given by the St. Pat's Board and held in the gymnasium, each fraternity has the privilege of holding three dances each school year.

The Freshman dance is the first big hop of the year. At this time the new men are welcomed to the school, and provisions are made to assure them of meeting other young people that the freshman would not ordinarily come in contact with.

In the fall months the week-ends are taken up by the nine social fraternities, who honor their pledges with informal dances. These dances are program affairs with attendance by invitation only.

Homecoming in November calls for one of the largest dances of all the year. An orchestra is imported and the students and alumni dance in the gymnasium under beautiful decorations. The dance is preceded by a football game, and if the Miners win, the occasion is indeed hilarious.

As the semester rolls along it is time for the Christmas Formals given by the fraternities. Each house plays host to gay crowds in formal attire, with the snow often adding a background to the outside decorations of St. Nick and his reindeers. As the Miners are looking forward to the vacation and home, these dances are top notch affairs. Young ladies are brought in from St. Louis, William Woods College, Stephens College and the University of Missouri, as well as from many other towns in Missouri and neighboring states.

After their return from the Christmas Holidays, the students thoughts go to the approaching St. Patrick's Day festivities. Several dances are given by the St. Pat's Board throughout the year in order to finance the main St. Pat's celebration.

At last the Spring Holiday arrives For three days the Miners are free to celebrate the exit of snakes from Ireland, and to welcome the patron saint of all Engineers—St. Patrick himself.

On Thursday night the nine fraternities and the Independents play host in rotation to the several hundred guests on the campus. These are very informal affairs with the dancers coming and going at will. Starting at 10:00 p. m. they wind up early in the morning with waffles and coffee.

Early the next morning St. Pat arrives in town via a handcar on the Frisco Railroad. Accompanied by his guards and a large entourage of noisy celebrators, he wends his way to Parker Hall. There he knights each senior into the royal order—each one receiving a shingle, while the venerable saint reveals the senior's misdoings in his four years at MSM. The Blarney Stone comes into the spotlight as each senior bends over to smack a resounding kiss on its scarred surface.

That night the Miners swing into the spirit of things to the music of a nationally famous orchestra. This year Frankie Masters and his band presided, and he drew much praise for his music and his outstanding personality. The ball is costume, and many varied hues add color to the affair.

Promptly at midnight the heralds clear the way for St. Pat, who first receives the various fraternity maids of honor.

While the dancers are dressed in costumes of various kinds, the maids of honor are in evening gowns. Then the queen of Love and Beauty is escorted to the throne to be crowned Thus the Engineers assume a queen for the next year.

The rest of the night is spent in dancing, until the happy couples wend their way home amid cheery good nights.

On Saturday afternoon one of the fraternities annually plays host to the celebrators at a tea dance. The official program winds up that night with a formal ball in the gymnasium, with the same orchestra playing. Partings next day are sad, for it is a whole year before St. Pat is welcomed again.

The yearly dance program is concluded in the Spring with Farewell Dances, given by the fraternities and are invitation dances.

On the night before graduation the faculty of the MSM plays host to the school in a Farewell Dance. This is a gala affair, with the underclassmen celebrating the coming holidays and the seniors their graduation.

However dances are not the only form of social life at MSM. There are a number of professional societies on the campus which hold weekly meetings, frequently with nationally known speakers, to discuss their mutual interests, after which refreshments are served and several minutes spent in visiting.

The Churches provide programs for young people and the MSM students are asked to participate. Parties are held, suppers are given, and one church has a dramatic club.

The School of Mines also provides for those interested in dramatics through a local chapter of Alpha Psi Omega. This organization presents two plays a year, all students being eligible for membership.

ST. PAT'S

The General Lectures Committee presents outstanding speakers and lecturers on its program, which is also open to students. Among the late speakers have been Mrs. Osa Johnson, Thomas Hart Benton, J. B Priestly, Capt. W. W. Hodge and C. W. Muehlberger.

Other attractions have been the R. O. T. C. Band in their annual concert and Stunt Night for the campus organizations.

In this way does the School of Mines provide social life for its students. A well-rounded life while in school tends to produce a well-rounded engineer in later years.

GEOLOGY OF MISSOURI

(Continued from Page 5)

mations. In Ste. Genevieve County the Oriskany limestone is quarried to produce a richly colored marble.

The Mississippian series outcrop extensively in northeast and southwest Missouri. Again in ascending order this series consists of a number of formations including the Kinderhook, Burlington-Keokuk, St. Louis, Ste. Genevieve and Chester formations. The entire series is largely composed of cherty limestones. The marble quarried at Phenix, Carthage and Joplin is produced from the Burlington-Keokuk formations. One of the most extensive high-grade lime industries located at Ste. Genevieve is based on the utilization of the very pure limestone at that point. The lead-zinc deposits of southwest Missouri, Oklahoma and Kansas occur in the Keokuk-Burlington series.

The prairie region of northwest Missouri is underlain by the Pennsylvania or Coal Measures strata which consists largely of shales, sandstones and limestones. In these formations occur the commercial coal seams varying from 1 to 6 feet in thickness. Extensive deposits of high-grade fire clay occur in the lower portions of these formations and in the western part of the state extensive deposits of shale occurring in the upper beds are used for sewer-pipe, tile and common brick. Small pools of oil and gas have been found in Jackson and adjoining counties within this series of rocks.

Still younger in the geological column are the formations underlying the lowland area of southeast Missouri. These consist largely of clays, sands and gravels. Because of the small amount of relief in the region outcrops are not common. Throughout north Missouri the hard rock formations are covered with the so-called glacial deposits which consist of clays, sands and boulders brought in from the north by the great ice sheet which puts its way south to the present valley of the Missouri River. The melting of the ice deposited this material over all of north Missouri.

This brief outline includes the varied formations underlying the state. This variation in itself has been the basis for a wide variety of mineral resources. The Ozark region is one of the important mining areas of the United States and in it occur most of the metallic minerals found in Missouri. The northern portion of the state and to some extent in the Ozark region we find chiefly the non-metallic deposits which from a monetary standpoint have a greater annual production than the metallic. The total annual production varies in value from $30,000,000 to $50,000,000.

Missouri Geological Survey

The Missouri Geological Survey and Water Resources, with headquarters in the old Rolla Building on the campus of the Missouri School of Mines and Metallurgy at Rolla, is an independent, scientific State bureau, devoted to the development of the natural resources of the state. The work of this bureau is divided into three branches, namely, (1) Mining and Geology Branch, (2) Water Resources Branch and (3) Topographic Mapping Branch.

Mining and Geology Branch: This branch is devoted to the development of the mineral and ground water resources of the state. If Missouri were underlain by one uniform stratum of rock, geologic conditions would be uniform and there would be practically no variation from one end of the state to the other. As a matter of fact there is a great variation in the formations underlying the state and this difference may occur in very short distances. Due to the fact there are no two areas in the state where the geology is the same. Ore deposits do not occur accidentally, but are the result of certain geologic processes, a knowledge of which is of great assistance to prospecting and development. It is the province of the Geological Survey to investigate the geologic occurrence of the various mineral deposits of the state and through printed reports disseminate this information to citizens, landowners and investors.

The acute drouths of the past few years have centered public attention on the ground water resources of the state, and the Geological Survey maintains a close cooperation with the State Board of Health in the drilling of wells for public water supplies. This work is effective through determination of the casing point in keeping out contaminated surface waters, and is therefore an important factor in the matter of public health.

Water Resources Branch: The Missouri Geological Survey in cooperation with the United States Geological Survey maintains some 90 gauging stations on the principal rivers of the state. Hydro-electric development, flood control, soil erosion and many other important factors depend upon stream flow and the records obtained through this work is of the greatest value in any study of the state's surface water supply.

Topographic Mapping Branch: An accurate map of the state is being made by this branch of the Survey in cooperation with the United States Geological Survey, the State Highway Department and the Works Progress Administration.

These maps are of the same character as are being made in every other state in the union. They show the location of all streams, land lines, houses, churches, school houses, roads and the surface above sea level by brown lines. They are the most accurate maps made. Approximately fifty per cent of the state has been covered.

The Engineer Looks Ahead

By F. L. CLARIDGE '39, MAX BOLOTSKY '39

Introduction

It is one of the most intriguing fancies of mankind to attempt to look into the future and predict the world of tomorrow. But for young people attempting to plan in some general fashion their lives, it becomes a matter of the utmost importance to have some definite indications of what work may lie open to them when finally they finish their years of preparation and enter into their life's work. To set a few guideposts in the field of engineering is our aim in this article.

Old industries are dying and new ones are constantly being created in this kaleidoscopically changing world. In the space of a comparatively few years a new industry, resulting from some discovery already known, may grow to such importance that it will eclipse all others in its own field. We have an illustration of this in the automobile. Since the beginning of this century the automobile has grown to surpass all other forms of transportation in rate of production and volume of traffic. In chemistry, the production of dyes, paints, rubber, and medicines from natural sources has been gradually giving place to the synthetic products, until soon these sources may be discarded entirely.

The social and economic implications and results of these changes are becoming of extreme importance. A number of very grave problems arise as a direct result of these technological changes. Unemployment grows with increasing rapidity. Implements and materials of destruction are becoming of such terrible effectiveness that a general great war might mean the destruction of civilization. The engineer of tomorrow must cope with these and other problems of a social nature, so let it be remembered that while great new engineering projects and problems await the coming engineer, and the technical changes in industry will be of great importance to him, as yet unpredictable social changes may wreak such a great transformation in his world that these will be major factors in his choice and method of carrying on his work. These technological trends which we are outlining below are therefore only a part of the trends which will greatly affect the engineer of tomorrow.

MINING ENGINEERING

Although there have been no striking changes in the art of mining during the last five years, still there have been some developments in the mineral industry whose significance has not been deeply felt until recently and which created problems the mining engineer of today and tomorrow will have to solve.

Of grave importance has been the steady decline in the grade of ore available for mining. Not a new problem but one of increasing seriousness, it has brought to a high scientific level an old field, that of ore dressing, which concerns itself with the preparation of ores and minerals for further treatment by which the valuable portion can be gained. Not so long ago floatation, whereby, through the employment of certain reagents and the introduction of air, constituents of the ore are removed in the form of froths, was the big thing in ore dressing. In the near future floatation will see continual expansion, particularly in its application to non-metallic minerals such as limestone, talc, and fluorspar.

However, still in their infancy are other methods of ore concentration. Among these can be listed electrostatic separation, alternating current separation, and heavy liquid separation. The first two are based on the electrical properties of minerals, and the latter utilizes the difference in specific gravity of two ores.

All of this work requires thorough testing of ores, mineralogically, physically, and chemically, before an ore body can be developed.

It is the mining engineer of the near future who will be concerned with the application and further development of these new methods of ore dressing and, as has been seen, a real aptitude for physics, chemistry, mineralogy, and other allied subjects must be his if he is to be successful.

Although ore dressing will undergo steady expansion, finding new ore deposits will probably be the most important development of the future in mining from the scientific standpoint. Geophysics, which has been successfully applied to the location of new oil fields, will be the engineer's chief tool in this research, and prospecting as of yore will soon vanish. We shall deal in more detail with geophysics in our discussion on mining geology.

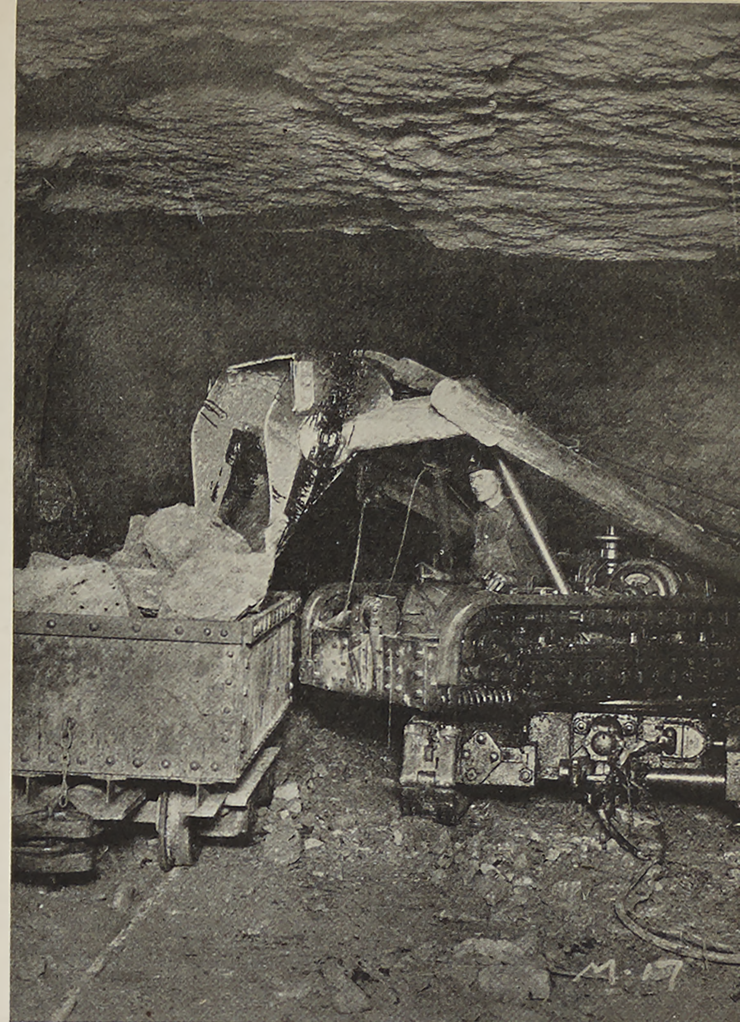
Probably the most significant development of social consequence in mining engineering is the mechanization of coal and metal mines, the substitution of machines to reduce hard labor. Toward this end the use of underground loading machines to take the place of hand loading has made the greatest stride in the last few years. As late as 1923, hand shoveling in the

WORK OF THE CIVIL ENGINEER

coal mines was the largest single task of some 490,000 men. Today in a mine thus mechanized hand shoveling has been virtually eliminated. Underground transportation is being cheapened too through the introduction in succession of electric haulage locomotives, rubber tired electric driven trucks which do not require tracks, and belt conveyors which eliminate cars altogether.

Mechanization has changed the methods of mining radically. Directly it has concerned the mining engineer in creating a greater demand for him. Especially is this true in coal mining. But with mechanization has come technologic unemployment. In the mining industry, more so than in other fields of engineering, the labor problem is acute. Hence, of equal importance with technologic skill will be knowledge of social relations. The mining engineer of the near future must be amply prepared in the latter.

Last of the major developments in mining engineering is improved safety practice. Nurtured since 1908 by the United States Bureau of Mines, safety practice is now largely a matter of education. We know what the safe practices are. The problem is to educate the workman to their use. This is another big job for the mining engineer.



Underground loading. The mining engineer, the geologist, the mechanical engineer and the electrical engineer must all play a part.

PETROLEUM ENGINEERING

The trends in petroleum engineering may be listed under four categories—production, transportation, refining, and synthetic manufacture.

We have already indicated the important role played by science in the discovery of oil fields. This same application of the scientific attitude now characterizes the production end. The technique of producing the oil from the wells is being revolutionized. Scientific analysis of the conditions that control the occurrence of oil and gas has indicated many desirable modifications of traditional practice. This should lead to the employment of more petroleum engineers and, in turn, should demand of the graduate technical ability of a high order.

Another outstanding development in production has been the construction of portable drilling units. Through their use, much valuable time has been saved by the companies in drilling their wells. Within the last five years improvements within this line have enabled some companies to cut drilling time in half, thus effecting a saving of several thousands of dollars per well. A great deal more will be done during the next few years with this practice.

The evolution of pipe-line transportation is one of the chief technologic contributions of oil and gas engineering. Born in the 1880's, pipe line systems during the last 15 years have evolved tremendously. Since 1927 about 5000 miles of pipe line have been built to transport gasoline and other refined products. At present gasoline is being transported from Oklahoma to Chicago, St. Paul, and Minneapolis in this manner. Unquestionably the future will see an extension of both production and distribution gas and petroleum pipe lines.

Although petroleum refining and making synthetic oil should properly come under the heading of fuels and under the jurisdiction of the chemical engineer, who is as vitally concerned with them as is the petroleum engineer, we are including them in our present discussion.

The three major advancements in refining, all tending toward the conservation of the oil resources, are cracking, solvent refining, and polymerization. The first, which is not a new process, has to do with subjection of heavy oil to high temperatures and pressures in order to gain gasoline from it. The second is a new improvement in refining technique through the use of solvents to separate impurities from lubrecation oils. The third is a method recently put into commercial use whereby gasoline is made from natural gas and other light hydrocarbons. Especially in these last methods should the future see important developments.

In line with the trend toward conservation in the oil industry several methods of synthetic gasoline manufacture are being developed. They are hydrogenation, the combining of hydrogen with carbon to form gasoline and other light hydrocarbons; the byproduct reclamation of oil during the making of coke; and the extraction of oil from oil bearing rock. Of these, hydrogenation is already practiced in Germany, but its high cost prohibits its application in the United States. And from these other two sources, because of high cost and lack of development, no substantial supplement to our supply of petroleum will be available during the next 10 years.

Substitution of alcohol for gasoline is another possibility. In summary, however, it may be said that we anticipate no great industrial development of petroleum substitutes in the country during the next 10 years, but we may expect a steady increase of experimental and semi-commercial work looking toward the utilization of substitute materials when economic conditions warrant.

GEOLOGY

In the main the activities of the geologist five years from now will be conducted along lines that are being laid down today. No radical change in methods is expected. Rather, the present trend toward making geology a more exact science by increased reliance upon physics and chemistry will continue and the fruits of such a tendency should be gathered then more than today.

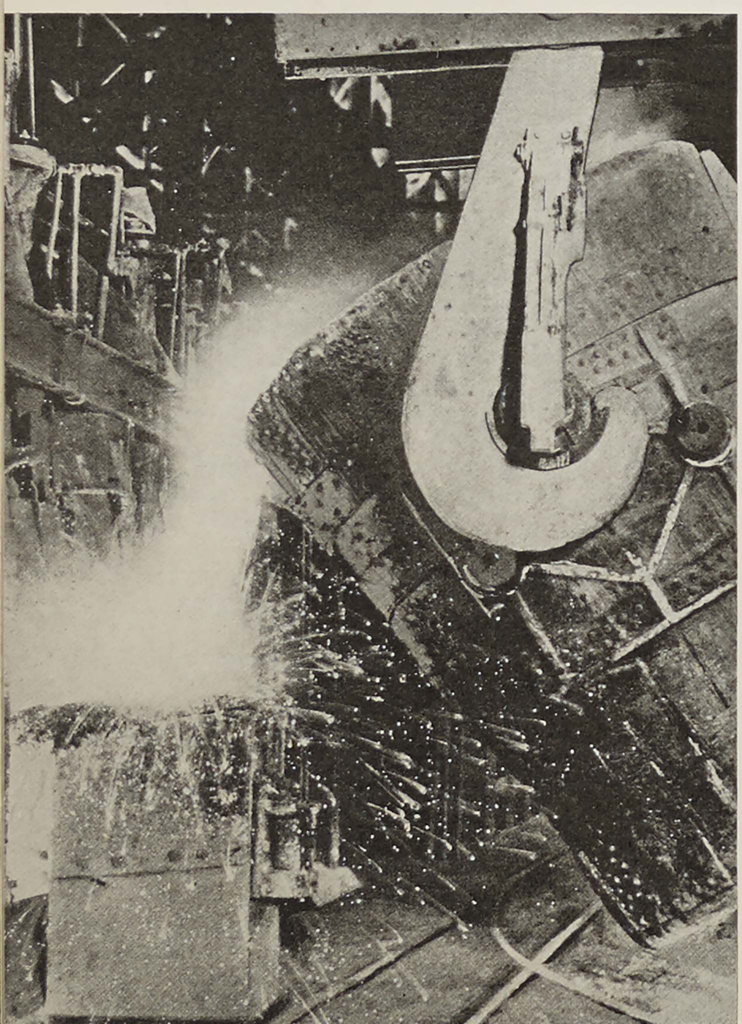
The tool upon which the geologist has been relying more and more in seeking mineral wealth within the earth, oil and metalliferous deposits where no surface indication exists or in determining structural features of the rocks which may affect engineering works, is geophysics. This contributtion of the physicist to the geologist utilizes sensitive instruments to determine the pull of gravity, the effect of the earth's magnetic field, the rates at which vibrations are transmitted through rocks of different types, and other measureable effects that may tell of conditions deep below the earth's surface.

Until now geophysics has achieved its greatest success in the field of petroleum development. To a minor extent only has it been of service in unearthing metal bearing deposits. Of the geophysical methods used, seisomographic and those involving measurements of gravity have been chiefly employed. Hence the future points to extensive and improved application of these two methods in seeking minerals other than petroleum and the development of those geophysicals methods that utilize the measurable electrical properties of the earth for service in this field.

At present the search for oil is governed largely by the geologist's interpretation of underground structural traps. Geophysics will continue to play a major part in this interpretation. However, geophysics and other existing methods are unavailing in seeking out one type of oil trap that has supplied 30% of our oil to date. This is the shoreline of a long buried sea. Twisted and then covered over by horizontal beds of rock, the shore boundary constituted a trap in which oil pools were formed. Geologists today are making definite efforts to devise some means of locating pools of this type, but the solution is still for the future.

A third trend in mining geology is the study of geochemistry. By studying the behavior of minerals and rocks under high temperatures and pressures and under weathering conditions, the origin of ore deposits can be deduced. Knowledge of the latter will enable the prospector of the future to conduct his operations more intelligently.

POURING MELTED STEEL



The metallurgist, the chemical engineer, and the ceramist control this operation.

METALLURGICAL ENGINEERING

To state that the metallurgical engineer of the near future will be carrying on the practices now in effect in the metallurgical industry and developing those possibilities that research has pointed out is simple. But setting forth these tendencies in the small measure of words allowed in this article is not simple. Necessarily it must be a task that will fall short of completeness. With full knowledge of this, we continue.

There has never been such intense activity in the field of development and improvement of alloys and steels as there is today. Now instead of a handful of commercially used metals as at the beginning of the century, there are 35 in active industrial use. These metals enter into the composition of some 5000 different alloys and steels. Competition in the metals business is keen. Aptly called the "Battle of the Metals," this competition sees great rivalry between the non-ferrous alloys and the steels and between the components of each of these fields themselves.

Of definite trend is the greater use of the light alloys. Made possible by outstanding advances in the production field of metallurgy, whereby metals 99.99% pure are now attainable commercially, the non-ferrous light alloy field is now a decided competitor of the noble stainless steel alloys. A supreme example of their significance has been the aircraft industry, which could never have attained its present eminence were it not for aluminum alloys. Available today are all kinds of structural shapes made from light metals alloys; by their use structures are possible today whose requirements steel could never fulfill because of excessive weight.

Into important practice is coming the revolutionary art of powder metallurgy, whereby metals and alloys are prepared by heating to incipient fusion and then compressing metals in the form of powders and other small particles. The oldest and best known reason for using powdered metals is for the preparation of refractory metals like tungsten, tantalum, columbium, and molybdenum, unprocurable otherwise. But this metallurgy is not being limited to the refractory metals alone; its application is also being made to such metals as copper, lead, zinc, iron, and aluminum. Alloys of novel character and materials of outstanding properties are made by this method. As yet its possibilities have been little explored and the present four large scale operations in refractory metals, hard carbide tools, porous bearings, and electrical contactors will be augmented by others where the end results can be achieved more cheaply and effectively when starting with powders.

Tungsten, tantalum, and columbium, the laboratory curiosities of not so long ago, are rising to great prominence. As alloying elements in steel they impart corrosion resistance at high temperatures, extreme hardness, and all around enhanced physical properties. As carbides, in the form of tools and dies they are bringing great advances into the cutting and machining of very hard materials. Tantalum in the pure state and alloyed is proving its superiority in resistance to corrosion by a wide variety of inorganic and organic reagents. Definitely the metallurgy of these metals is on the rise.

The greater rise of light alloys, powder metallurgy, the utilization of the refractory metals—these constitute but a portion of the metallurgical picture. We could also have dwelt on the use of stainless alloys for decorative purposes in the railroad field; die casting, which lends itself to the production of intricate castings in alloys based on lead, tin, aluminum, copper, manganese, and zinc; marked advances in the welding of brass and copper; the hard surfacing of products; and many others. And still no narrating would have been done of the tremendous inroads of mechanization into metallurgical practice as a whole, of continuous rolling and casting in the mills, for example; and of the great volume of research, both practical and fundamental, that characterizes metallurgy today.

Truly the future holds much promise for the metallurgist.

CERAMIC ENGINEERING

Ceramics in the past has been so steeped in tradition that it has been only during the last 40 years that scientists and engineers have been recognized in the profession. During this time of cut-and-try methods an exceptionally large amount of data had accumulated. However, within the last 10 years the ceramist has gained a better insight into the fundamental principles which operate in the chemical reactions that take place at the high temperatures employed in maturing ceramic products. The fundamental sciences, physics, chemistry, and mathematics, have been called in, and now the accumulated data of the past is being transformed into the widespread and diversified products of the whiteware, glass, and refractory industries.

The degree of mechanization existent in ceramics is well illustrated by the blowing machines, which manufacture an incredibly large number of electric-lamp bulbs, drinking glasses, glass tubes, or bottles in 24 hours. One need of ceramics today is a machine which will eliminate the tedious hand-forming methods now necessary in the production of dinner ware. The design of this machine and further mechanization to reduce manufacturing costs will undoubtedly come about.

The field of raw material is fast being expanded to include minerals which had never before been considered for ceramic manufacture. Only the surface has been scratched in this expansion.

Improvements in technologic procedure will increase. The trend now is toward the building of tunnel kilns having a smaller cross sectional area in order to get more uniform heating and attain the maximum temperature in a shorter time. Better products at only slightly decreased rate of production will result. Another trend is the vacuumizing or deairing of clay in the formation of white ware and structural clay products. This practice may open up new fields hitherto unexplored by the ceramist.

The displacement of metal and wood by ceramic products is now in its ascendency. Inkling of the widespread use of these products may be gleaned by consideration of the following: glass in various forms will be used for textiles, building materials, and cooking utensils; porcelain enamel on steel will be used for surfacing buildings; prefabricated houses of brick and tile will compete with the present home of concrete and wood; prefabricated brick slabs will reduce highway construction costs. Other improvements will come about, such as chemical porcelain possessing greater mechanical strength and resistance to heat shock, better grade of cements, and refractories capable of withstanding higher temperatures. The list is endless.

Step by step with improvement is always research. In the field of fundamental ceramic research the x-ray and petrographic microscope will come into wider uses in ascertaining the properties of the raw materials and the fired products.

CIVIL ENGINEERING

Civil Engineering today includes such diversified branches as Surveying, Hydraulics, Transportation Engineering, Structural Engineering, Sanitary Engineering, and City Planning. Rapid progress is being made in all of these fields.

The basic fundamentals of fluid mechanics concerns such subjects as hydraulics, ventilation, heat transfer naval architecture, and aeronautics. At the present time the over-abundant use of experimental coefficients and empirical formulas in these fields is alarming, and attempts are being made to eliminate the use of such constants and place fluid mechanics on a more stable and sound basis.

Hydraulics is the study included above that is of major importance to the Civil Engineer. The necessity and consequence of laboratory experiments is being more and more recognized and is evidenced by the increasing number of hydraulic laboratories throughout the country. Numerous studies are being made on various types of weirs, conduits, open channels, hydraulic jump, water hammer, and physics inside a water jet. All this study should lead to many valuable discoveries.

Other advances are expected through the investigations of the structural properties of soil and the methods of the evaluation of those properties. Our knowledge of soil and its properties is practically negligible in comparison to the knowledge of the properties of such modern construction materials as steel, concrete, and timber. The stability of almost every engineering structure depends in some measure on soil and its structural properties. The engineer is confronted constantly with the action of freezing, thawing, sliding, compressing, eroding, or washing on soil. Soil stabilization is one of the biggest factors being considered by highway engineers today. Cuts, fills, subsoils, all govern the possible success and economy of maintenance of our modern highways. A great deal of study is being made in this field and will resolve into many valuable discoveries. It is possible that the majority of our rural roads will be greatly improved at a low unit cost as a direct result of these investigations.

Structural Engineering, especially in concrete structures, is undergoing a decided change with an increasing use of rigid frame structures. The first structure of this type was constructed in 1922, a comparatively short time ago. However, the main development has been since 1930, when Professor Hardy Cross of the University of Illinois introduced his method of moment distribution, arriving at the final design by a far more simple manner than before was known. Enough of these structures have already been built to prove their worth.

These rapid strides in the numerous branches of Civil Engineering will lead to a more comprehensive knowledge of those subjects and will be an aid to all fields of engineering.

MECHANICAL ENGINEERING

Mechanical engineering has made several remarkable advances in late years which promise to make widespread differences in industry and everyday life. One of these is the development of the high-compression gasoline engine, with an increase in efficiency of about 15% over the motors of ten years ago; another is the development of light weight, efficient Diesel engines; again there have been very important changes in the construction and use of steam boilers and engines; light alloys have made possible very high speed and high powered airplane engines; developments in welding are causing replacement of cast machines by ones fabricated from standardized shapes of metal.

Air conditioning is properly a branch of mechanical engineering, yet has grown to such major proportions that it now is a specialized field in itself. There is a definite demand for trained engineers in this line, and increased knowledge of its possibilities will undoubtedly finally result in its incorporation in the air circulation system of all buildings, cottages as well as skyscrapers.

The Diesel engine has been the focus of intense effort for nearly a generation, in the effort to make it practicable for commercial use. Today, General Motors is producing Diesel-powered automobile engines, of which the cost of operation is one-third of that of the present gasoline car. The Baldwin Locomotive Company is producing stream-lined Diesel locomotives for railroad traffic. Half of the merchant marine is now powered by Diesels. It is very probable that the application of Diesel engines will grow still further in importance.

Here the question of fuels, properly treated under chemistry or petroleum engineering, enters the mechanical field. Certain of the alcohols have been used as fuel in engines. Should this increase in usage, special construction of engines will be necessary to use the fuel.

The production of better fuels and the development in lighter alloys has enabled the mechanical or aeronautical engineer to construct airplane engines with a weight per horsepower rating as low as 1.5 lbs. per H.P., with resultant airplane speeds of over 400 miles per hour cruising speed for combat planes and 150 m.p.h. for pleasure craft. Air conditioning and supercharging entering in here now make possible stratosophere planes, which will probably become a regular service in the near future.

ELECTRICAL ENGINEERING

Electrical engineering has become perhaps the most profound of the engineering sciences, and the wonders it can perform seem to be without end.

Among the latest experimental and practical developments in electrical engineering with which the engineer of the future may be deeply concerned are: Television, the sending of thousands of messages over a single wave directed through a metal tube, high frequency co-axial cable, electro therapy, geophysical prospecting apparatus, industrial applications of the x-ray, home appliances, and, perhaps today the most potentially important of all these, the electron tube.

There is now a growing demand for men trained both in electrical engineering and also in other fields, as geology, biology, physics, chemistry, mining, or petroleum.

Space does not here permit an adequate description of the endless uses of the electron tube in its various forms. Suffice it to say that it is now in use in hundreds of applications from radio and arc welding to control of factory automatic machinery and starlight measurers.

The importance of electrical home appliances can hardly be realized without comparison with the home of twenty-five or thirty years ago. Electricity has wrought more changes in home life than any other one development of the twentieth century. Perhaps one of the broadest field of application for the electrical engineer of tomorrow is in the field of home appliances—in their spread through the homes of the nation.

The medical and biological applications of electricity grow tremendously today, and in the years to come may furnish the answer to many problems of life functioning and disease curing which have puzzled men for years. Diagnosis and cure of many little understood phenomena, particularly nervous and mental diseases, are entirely new fields just beginning to show possibilities.

Geological exploration of under ground strata has long been a hit-or-miss proposition, but with the modern methods of seismographic and electromagnetic surveying it has been placed upon a scientific basis.

It has now become possible to send over a million messages, or 2000 television broadcasts simultaneously over a copper pipe two inches in diameter. This is such a great advance over all previous conductors that they will probably eventually replace our present broad network of wires.

Television is slowly but surely being commercialized, and so soon as it reaches widespread use it will be acclaimed as perhaps the greatest of the inventions of the last twenty years. It is a coming field in electrical engineering.

CHEMICAL ENGINEERING

One planning to select chemical engineering as a profession should consider what will be the probable opportunities when he graduates four years hence. Before he can consider these opportunities intelligently he should have a clear idea of what a chemical engineer must do after graduation.

A chemical engineer is concerned with the building and equiping of chemical plants, the operation of chemical processes, research on and the development of new processes and later, after he has acquired experience, the executive duties pertaining to the operation of chemical industry in its many ramifications.

Fundamentally the study of chemical engineering is the study of unit operations, such as filtration, heat transfer, flow of fluids, absorption, extraction and distillation. It will be noted that these operations are largely physical in nature but when applied to the many chemicals encountered in chemical industry it is obvious that the chemical engineer must have a thorough knowledge of the chemistry of the materials being handled. These unit operations are common to many chemical industries, the order of their sequence being the major difference. Even though radically different materials are handled in various chemical plants, still the fundamentals back of these unit operations are the same. Thus, all chemical industries have much in common and the arrangement of the various unit operations in the proper order constitutes a chemical process such as sugar manufacture, sulfuric acid manufacture, etc.

Remarkable advances in chemical industry have been made in recent years, to enumerate the details of which would require reveral books. A few of the more prominent examples will have to suffice. Artificial rubber has been made and, although it still remains more expensive than natural rubber, it is being manufactured on a limited scale as it has properties in its own right which make it valuable for certain uses where rubber falls down. Bromine is being extracted from sea water for use in the preparation of the fuels our modern internal combustion engines require. These same fuels have been improved by the addition of tetraethyl lead. Gasoline is no longer the fuel of five years ago, but has been improved in quality and increased in the quantity produced per barrel by polymerization of cracking still gases and natural gas. These same gases have become a starting point for the synthesis of many organic chemicals whose production in commercial quantities has heretofore been economically undesirable.

Plastics have replaced other materials in uses where they have proved superior. Artificial textiles such as rayon and cellulose acetate have been improved but still leave much to be desired in competition with natural

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Athletics At MSM

By BASIL COMPTON

Athletics have always played an important part at the Missouri School of Mines, although in no way does football, basketball and track step out of its proper place in the life of the engineering student. The varsity sports are there for those better athletes who want to represent the school on the field.

For the other students there are various intramural sports, where the contestants compete against athletes of their own caliber. This affords many students training that they would not get were there only varsity sports.

Following the seasons we first find that grand gridiron game—football. The first practice for the Miner eleven starts with Freshman week, and each evening Coach Gale Bullman may be found on the field directing a squad of men through setting up exercises, fundamentals, and blocking and tackling workouts.

The Miners compete in the Missouri Intercollegiate Athletic Association, conference which is composed of the five state Teachers Colleges at Maryville, Kirksville, Cape Girardeau, Warrensburg, Springfield, and the Miners. Besides having one game with each team in football, Coach Bullman schedules three other teams each fall. St. Louis University at St. Louis has been on the list for a number of years.

Last year the Miners traveled to Oklahoma City for one game, and for several seasons have gone to Arkansas and Kansas for games.

Coach Bullman made his debut at the School of Mines last fall and was successful in steering the Miner eleven to third place in the M. I. A. A. The Miners lost conference games to Warrensburg and Cape Girardeau and tied the game with Kirksville.

The Miners opened their season by trimming the Carbondale, Ill., Teachers by a large score, but then ran into a snag when they invaded St. Louis for their annual game with the St. Louis University team. Incidently the MSM R. O. T. C. Band accompanied the team to St Louis along with some three hundred rooters.

Then came the five conference games and the trip to Oklahoma City. The Miners defeated Springfield and Maryville and lost to the Goldbugs of O. C. U., at the same time they were tieing Kirksville and losing to Warrensburg and Cape Girardeau. The Cape Indians then went ahead to win the M. I. A. A. championship.

The basketball season was hardly as successful as the football season, but next year's team should jump up another notch or two in the final conference ratings. Basketball as played in the M. I. A. A. is the fastest in the middlewest. Warrensburg won the loop title then proceeded to annex the National Collegiate Championship in a tournament at Kansas City, Mo. Later in the season the Mules went to the National A. A. U. tournament at Denver, Colo., where they were eliminated in the semi-nals after trimming all collegiate competition.

Only one man, Capt. Charles (Buddy) Clayton, will be lost to the Miners basketball squad next fall, and with eight lettermen returning, the Miners should have a successful season. Coach Percy Gill, former Missouri University star, will continue his coaching duties in basketball.

Track has always been a favorite sport at MSM and this year's team will be about as strong as those in the past. The Silver and Gold colors were carried to third place in the M. I. A. A. indoor meet at the Brewer Field House, University of Missouri, Columbia, last month, and Bullman expects his charges to annex the majority of their outdoor meets this spring.

The Miners are strong in the distance events where George Fort runs the mile, and Norman Tucker the two-mile. These two stars are only sophomores and should break records before they wind up their inter-collegiate careers.

Besides track, the Miners round out the spring season with tennis and golf teams, and usually the Miners give good accounts of themselves. The School of Mines has two new concrete tennis courts, where the Engineers may workout throughout the year. In the past a rain caused cancellation of meets, and practice workouts were limited. When teams from other schools called here, and their members had been playing on concrete courts, the Miners were at a disadvantage. Now the Miners play every time there is a track meet, both at home and away.

The School of Mines owns the golf course situated directly Northwest of town, and on sunny afternoons one can see quite a number of Miners playing. The course is open without charge to the students and they can play at anytime.

The MSM course is used when visiting golf teams come to Rolla. A four-man team also accompanies the Miners on their track trips, giving the golfers the same competition that the tennis and track teams receive.

The Intramural program at MSM is under the direction of both Coaches Bullman and Gill, and features the following sports in season: Touch football, basketball, handball, wrestling, boxing, swimming, horseshoes, track, tennis, golf, and softball.

The Independents are represented by four teams, Freshmen, Sophomore, Juniors and Seniors. The rest of the teams are drawn from the nine fraternities on the campus, each organization being represented by a team. Pledges as well as members are eligible for competition. Thus each student in school may participate in Intramurals.

All MSM students have the right to use the gymnasium at all times that it is open. This includes a swimming pool, basketball and handball courts, facilities for wrestling and boxing, and a ping pong table.

Miner sports are always kept on the highest level possible. Miner teams are always playing to win, but winning is not considered necessary at the cost of poor sportsmanship.

THE ENGINEER LOOKS AHEAD

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silk. It is interesting to observe that the first factories producing rayon and cellophane could not sell their products today at any price. The discovery and production of cellophane has changed the appearance of our stores from that of the "cracker barrel" era to that of the modern store. Advances in the production and use of lacquers has benefited mankind in many ways, notably in the food industry in the use of lacquer lined cans. All of these and many more have been made available through chemistry and developed to commercial production by the chemical engineer.

Advances in the near future will be a continuation of those in the immediate past. Air conditioning is a field which has barely been scratched, the fundamentals of which are the unit operations of humidification, dehumidification and heat transfer. Synthetic medicinals are being manufactured in greater numbers than ever before and will undoubtedly increase. Improvements through chemical engineering will continue in the field of lubrication. Greater and improved uses for farm

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Exhibits for Engineers' Day

AS ARRANGED BY DEPARTMENTS

The following displays will be on exhibit from 2:00 to 6:00 p. m. and 7:00 to 9 p. m., April 23rd, 1938

CERAMIC ENGINEERING DEPARTMENT

Ceramic products of the following industries will be on display: raw materials, refractories, stoneware, porcelain enamel, glass, structural clay products, dinner-ware, electrical and chemical porcelain, art pottery. (North end, second floor of Experiment Station.)

In the ceramic laboratories, methods of manufacture for various ceramic products will be demonstrated, such as the potter's wheel, casting art pottery in plaster molds, body preparation, glazing, firing, and porcelain enamel firing. (Ground floor, east side, Experiment Station.)

MINING AND PETROLEUM ENGINEERING DEPARTMENT

(Second floor hall and south end of second floor of Experiment Station.)

The Mining Department will arrange to have an exhibit on the second floor of the Mining Experiment Building consisting of:

(1) Coal screening plant in operation.
(2) Two wire rope tramways in operation.
(3) Exhibits of mine models, mine fan, rock drills, safety lamps, etc.
(4) Display of pipe fittings, rotary bits and other oil field equipment.

The Petroleum Laboratory will be open and have a Hughes Oil Pump in operation, besides miscellaneous oil testing equipment.

A rock drill will be in operation on the outside of the building, at the northeast corner. It will be operated by students who will test different types of bits and measure air consumption of the drill.

CHEMICAL ENGINEERING DEPARTMENT

(All laboratories in Chemistry Building.)

Demonstrations will be given in experiments in General Chemistry, Quantitative Analysis, Organic Chemistry, and the unit operations in Chemical Engineering.

GEOLOGY DEPARTMENT

The Mineral Museum will be open to visitors. It contains a complete collection of minerals from all parts of the world, with special emphasis on Missouri ores. (Room 208, Norwood Hall.)

A display of fluorescent minerals, chiefly from the Franklin Furnace District, New Jersey, will be shown under ultra violet light to bring out their fluorescence. (Room 209, Norwood Hall.)

DRAWING DEPARTMENT

(Room 101, Norwood Hall.)

The Drawing Department will display many of the representative types of student drawings, selected from the files, and covering a period of many years.

Several new-type drawing desks and boards, T-squares and other equipment will also be on display. Instructors and students will be present to answer questions and demonstrate use of the equipment.

METALLURGY DEPARTMENT

(First floor hall and assay laboratory, Metallurgy Building.)

There will be a display of metal products and of ores, mattes and slags, and the microstructure of common alloys will be shown.

The following processes will be demonstrated:

Ore to metal.
Physical testing of alloys.
Spectrography.
Fire assaying.
Ore dressing.
Electro-metallurgy.

MECHANICAL ENGINEERING DEPARTMENT

1. Exhibit of valves and other equipment by Crane Company. (Room 203 or 204, Mechanical Hall.)

2. Exhibit of 4-foot working model of railroad locomotive by Missouri Pacific Railroad Company. (Room 203 or 204, Mechanical Hall.)

3. Exhibit of a replica of the Gutenburg Printing Press (the first printing press) by Frederick Printing Company. (Room 203 or 204, Mechanical Hall.)

4. Modern airplane with various airplane accessories, by J. N. Foster, Curtis Wright Airplane Company. (Campus.)

5. Cut-a-way model of Diesel Engine by International Harvester Company. (Room 203 or 204 Mechanical Hall.)

6. Demonstration of air turbine run by compressed air, designed and built by Prof. A. V. Kilpatrick, Missouri School of Mines. (Machine Shop.) (Every hour during afternoon.)

7. Sporting goods display, designed and built by Prof. Kilpatrick. (Room 203 or 204, Mechanical Hall.)

8. Solution of differential equations pertaining to modern engineering, by means of Membrane Analogy, by Dr. A. J. Miles, Missouri School of Mines. (Room 203 or 204, Mechanical Hall.)

9. Glider and process of construction, by Glider

Club of Missouri School of Mines. (On campus if fair, in garage if rainy.)

10. Demonstration of gear cutting on a milling machine. (Machine Shop.) (Every hour during afternoon.)

1. Demonstration of critical speeds of balanced shafts. (Machine Shop.) (Every hour during afternoon.)

12. Method of showing accuracy of surfaces by light interference. (Room 203 or 204, Mechanical Hall.)

ELECTRICAL ENGINEERING DEPARTMENT

(Rooms 6, 7, 9 and 11, basement of Norwood Hall.)

1. *Tesla High Voltage Coil*: A rapidly oscillating current passed through one winding of the big coil produces more than 100,000 volts. (Every half hour during afternoon.)

2. *Osiso*: This exhibit shows the wave form of electric currents, and may be used to demonstrate the wave form of currents produced in telephony.

3. *Automatic Telephone Equipment*: Devices used with a dial telephone system showing the complicated mechanical response given whenever a call is placed.

4. *Bucking Broncho Motors*: Two dynamos with different types of windings are so arranged as to keep one of them reversing without outside control.

5. *Artificial transmission line*: Equipment for study of characteristics of long lines. (Room 6, Norwood Hall.)

6. *Automatic control*: Automatic starting and dynamic braking of motor. (Room 7, Norwood Hall.)

7. *Cathode-ray oscilloscope*: Shows shape of voice waves. (Room 6, Norwood Hall.)

8. *Dynamometer*: Method of load test of motors. (Room 7, Norwood Hall.)

9. *Electric welding*: Under-water welding. (Room 7, Norwood Hall.)

10. *Electro-magnet*: Shows force of attraction of powerful magnet. Keep watches away. (Room 7, Norwood Hall.

11. *Mystery lamp*: Lights without circuit connections. (Room 7, Norwood Hall.)

12. *Photo-electric cells*: Electric eyes for many control devices. (Room 7, Norwood Hall.)

13. *Ring the Peg*: Shows force acting on a conductor carrying a current in a magnetic field. (Room 7, Norwood Hall.)

14. *Selsyn Drive*: Transmits angular force and motion without mechanical connection. (Room 11, Norwood Hall.)

15. Speech transmission: shows transmission of speech over beam of light. (Room 11, Norwood Hall.)

17. Static bells: effect of charges of static electricity. (Room 7, Norwood Hall.)

18. Strength Tester: shows force required to generate electric power. (Room 7, Norwood Hall.)

19. Stroboglow: rotating objects appear to stand still. (Room 11, Norwood Hall.)

20. Stroboscope: shows effect of an intermittent light on moving objects. (Room 11, Norwood Hall.)

21. Thryatron motor: speed control by gas-filled tubes. (Room 7, Norwood Hall.)

22. Tin can motor: an induction motor with a tin-can motor. (Room 11, Norwood Hall.)

23. Ward Leonard speed control: a system showing a wide range of speeds and rapid reversals. (Room 11, Norwood Hall.)

24. Parallel operation of alternators: incorrect synchronizing produces lamp flicker. (Room 7, Norwood Hall.)

25. Phase-wound induction motor: illustrating control and test methods. (Room 7, Norwood Hall.)

26. Rotating magnetic field: illustrating effect of rotating magnetic forces produced by three-phase currents. (Room 7, Norwood Hall.)

27. Cashier's cage: demonstrating use of electron tubes for the protection of valuables. Courtesy of Westinghouse Electric and Manufacturing Company. (Room 7, Norwood Hall.)

28. The Union Electric Company of Missouri will exhibit and explain the operation and uses of the following equipment: Reclosing timer, Photo-electric regulator, Cathode-ray oscillograph, Sound motor, Calculating board. (Room 101, Norwood Hall.)

29. The Wagner Electric Corporation will display an exhibition illustrating the functioning of an Automatic Reset Overload Protection mounted on a Fractional Horse-Power Motor. (Norwood Hall.)

30. Burglar Alarm: Operated by the presence of the body. (Norwood Hall.)

CIVIL ENGINEERING DEPARTMENT

To Be Shown on the Campus West of Norwood Hall, from 1:30 *to* 4:30 *P. M.*

1. Class in Elementary Surveying actually doing field work.

2. Exhibit of surveying instruments including transits, levels, plane tables, alidades, sextants, level rods, range poles, tapes, chaining tripods and precision instruments.

3. The department's four-inch refractor telescope will be set up just west of Norwood Hall on the campus. Possibly sun-spots will be shown on sun-screen, and if conditions are favorable, a planet will be shown in the day-time.

4. Demonstrations with tension briquette machine, testing seven- and fourteen-day specimens, will be made.

5. The Missouri State Highway Testing Department will have a Bituminous Materials Testing and Soils exhibit. To be shown in the rooms and hall at the west end of the first floor of Norwood Hall.

6. Exhibits of students' work in structures and masonry design will be on display.

7. Work of N.Y.A. students on county and highway mapping will be on exhibit, and a limited

supply of sample county maps will be distributed to those interested.

8. Exhibit of stereocomparagraph which is used in the preparation of maps from aerial photographs.

9. A blue printing machine will be in continuous operation all afternoon, and suitable souvenirs of the buildings and campus will be printed and distributed.

10. The Bridge Division of the Missouri State Highway Department will set up a Beggs Deformator and several bridge models.

11. The Union Electric Light and Power Company of St. Louis will set up and operate a scale model of the Bagnell Dam.

12. Actual construction work in Civil Engineering will be in progress on the new Civil Engineering and Hydraulic Building west of the School garage on the campus. Several senior Civil Engineering students will be available to explain the work and the plans of the new building.

13. Operation of a large modern slide rule by student.

PHYSICS DEPARTMENT

1. An exhibit of several experiments:
   (Room 4, Norwood Hall.)
   - Mechanical advantage of simple machines.
   - Determination of shear modulus of a rod.
   - Bending beams: Young's modulus.
   - Coefficient of Thermal Expansion for a rod.
   - Use of the Wheatstone Bridge.
   - Electrolysis: Decomposition of water.
   - The potentiometer used to measure thermal E. M. F.'s.
   - Electromagnetism and Electromagnetic induction.
   - Spectroscopy, including various types of spectroscopes.
   - Electrostatics: Simple apparatus will be available for the observer to use in making experiments for himself.
   - Magnetism: Various types of magnets, including a consequent pole magnet, a thermoelectric lifting magnet and a "floating magnet," will be shown.
2. An exhibit of several demonstrations:
   - Electrical discharge tubes and the production of high vacuum, including properties of electrons, cathode rays, alpha rays, cosmis rays, photoelectronic and thermionic tubes, x-rays, etc. (2:30 and 4:30 p. m., Room 104, Norwood Hall.)
   - Polarized light and applications. Production of polarized light by various methods, applications to saccharimetry, stress analysis, etc. (3:00 and 5:00 p. m., Room 104, Norwood Hall.)
   - Geophysics. Lee partitioning method of determination of earth resistivities. The Hotchkiss Superdip Magnetometer. (On campus west of Norwood Hall, if fair, in Room 4, Norwood Hall, if rainy.)

MISSOURI SCHOOL OF MINES LIBRARY
(Parker Hall, upstairs.)

1. Pictorial illustration of the use of the School of Mines Library.
2. Reading machine, demonstrating the use of books on film.
3. Historical books on the Ozarks.

Exhibits for Engineers' Day as Arranged by Governmental Agencies on the Campus

U. S. BUREAU OF MINES
(Experiment Station, ground floor)

Machinery will be in operation demonstrating the process of continuous reduction of ore and the separation of minerals from ores by flotation.

U. S. GEOLOGICAL SURVEY
(Rolla Building)

Exhibit of methods of topographic mapping by aerial photography.

Detailed map of Lake of the Ozarks region.

MISSOURI BUREAU OF GEOLOGY AND MINES
(Rolla Building)

A display showing the mineral resources of Missouri and their sources.

Exhibit of water metering devices for stream gauging.

THE ENGINEER LOOKS AHEAD

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and trade wastes will occupy some of the chemical engineer's attention. Farming itself will demand some of the attention of the chemist and indirectly of the chemical engineer for the production of more and better fertilizers and insecticides. Recent discovery of certain plant growth stimulants forcasts the production of much more wealth per man hour for the farmer.

The chemical engineer will be found in every large industrial organization, participating in the rapid march of progress. His duties may confine his efforts to the executive department, research development, plant construction, plant operation, process control or technical sales. However, he will be found in the midst of things making every effort to produce better things for better living through chemical engineering and chemistry.

CONCLUSION

But the most important work of the engineer of the near future will be study and control of the social and economic effects of technological advances. The singular attitude of the Rust brothers toward commercialization of their cotton picker is a reflection of this movement toward recognition and control of such effects upon the nation. The engineer must assume the social responsibility which he has left to others and which these others have so woefully mistreated and neglected. Otherwise all our engineering progress is useless and harmful. This is the task of the engineer of tomorrow.